FORAGE PRODUCTION ON IRRIGATED HEAVY CLAY SOILS IN SOUTHWESTERN SASKATCHEWAN

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During the late 30s and early 40s, irrigation projects were established by the PFRA at various locations throughout southwestern Saskatchewan (Fig. 1) to provide an assured supply of hay to local producers. For economic reasons, these projects were located on the heavy alluvial clay soils of old lake beds where the flatness would facilitate flood irrigation. For years the producers on these projects have complained of poor yields. Recently our help was sought to determine why yields were low and to try to come up with ways of improving their yields.

Preliminary investigations showed that all the projects had several common features that contributed to the problem. Many of the stands had been down for a considerable number of years. Problems with establishment had led to a reluctance by the producer to plough down poorly yielding stands. The soils tended to be very low in phosphorus and in many cases a "plough pan" or very compacted layer seemed to have formed about 10 to 15 cm below the soil surface. The roots of many of the alfalfa plants appeared to have snapped at this point and secondary roots were growing along the interface. Grass roots, however, seemed to have less difficulty in penetration. Root rot was common among the alfalfa plants as was crown rot.

An experiment was established in 1979 on land owned by L. Grant at Val Marie to determine whether deeper tillage to improve subsurface infiltration and reduce pan formation would be beneficial, to determine whether increased available soil phosphorus would improve alfalfa yields, and to examine the possibilities of grasses fertilized with nitrogen producing higher yields.

The experimental area had previously been seeded to alfalfa and had been broken the year before. However, the low microbial activity and hence poor decay rate was evident from the persistence of root material. The soil was a deeply cracking, heavy (73%) clay soil with a pH of 7.5, Ec of 1.06 at the surface, but with evidence of salts at 35 to 45 cm, a bicarbonate P of 6 ppm, a field capacity of 52%, and a wilting point of 30%.

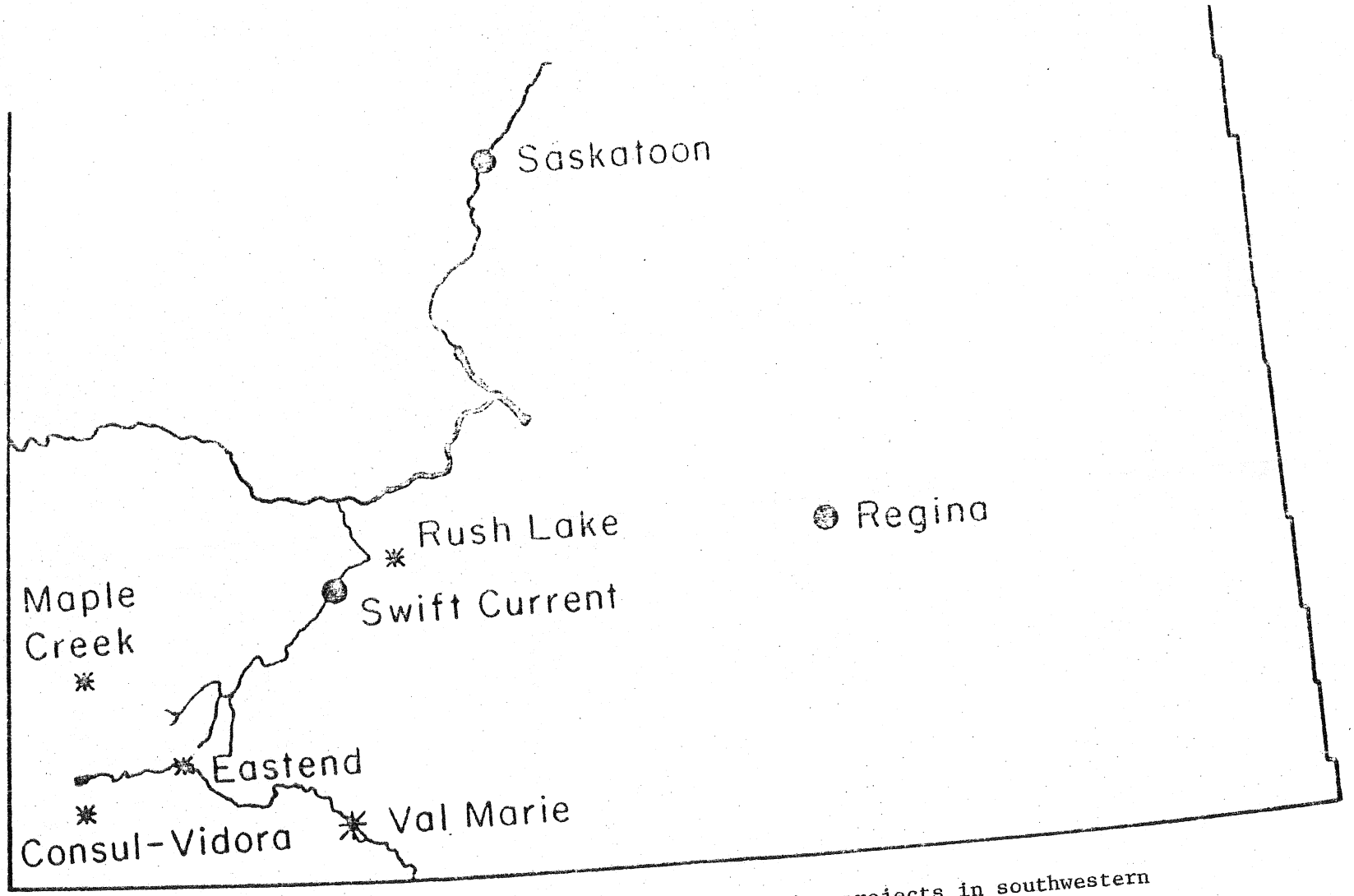

Figure 1. Location (*) of old established PFRA irrigation projects in southwestern Saskatchewan.

In the spring of 1977, arrangements were made with PFRA to deep disc (25-30 cm) one-half of the experimental area. The deep-tilled area and the shallow-tilled (5-7.5 cm) areas were then further divided into a three-replicate, split-plot design with phosphorus application as the main plot and a grass species x N fertility as the split plot. The phosphorus rates were 0 and 410 kg P_2O_5/ha incorporated prior to seeding. The split plots consisted of bromegrass, intermediate wheatgrass, and crested wheatgrass seeded alone, or seeded alone with 150 kg N/ha to be applied annually to the established crop, or seeded in a mixture with alfalfa. A check plot of alfalfa alone was also included as a subplot.

By the autumn of 1977 it was clear that establishment of many of the plots was poor because of drought and soil conditions. Intermediate wheatgrass and slender wheatgrass appeared to establish well. Establishment was particularly poor on the deep-tilled area. In the spring of 1978, the same grasses and alfalfas were overseeded into the same plots as in 1977. Establishment was better this time, especially where P had been applied.

Because of good growth in 1978, probably of the previous years seeding, one cut was taken in late June. However, because of stand differences and the double seeding, the results were disregarded. In 1979 and 1980 two cuts were taken from each plot, but in 1981, because there was not enough water for a second irrigation, only one cut was taken.

In 1979, the yields from these plots were well above those seen on the rest of the irrigation area. In the subsequent two years yields fell dramatically. Since, however, these were two very dry years with limited water, it is difficult to determine whether these lower yields were a result of a decline in stand performance or whether the decline was wholly attributable to weather conditions.

During the three years of observations, there was little change in the relative yields of the treatments. For this reason only the three year mean yields are presented (Table 1).

Deep cultivation only increased the yields of grasses fertilized with P. There was an indication in the first year that deep cultivation may have been beneficial to alfalfa, but the effect disappeared after the first cut.

Phosphorus increased the yields of both grasses and alfalfa, but it had little effect on the grass-alfalfa combinations. The reasons for this latter observation are not clear, but may be related to establishment problems.

There was a significant N and P interaction on grass yields with the highest yields occurring where both were applied. Since an application of 150 kg N/ha in a split application is considered low for

Table 1. Yield of Grasses and Alfalfa (3-yr Mean)

(kg DM/ha)

Species	No P			With P		
	Check	With N	With Alfalfa	Check	With N	With Alfalfa
			Shallow Cultivation			
Brome	2200	4900	5200	2900	5600	4200
CWG	2700	5900	5100	2600	6000	4100
IWG	2600	5600	4800	3200	6300	5300
Alfalfa	4000	-	-	5500	-	-
			Deep Cultivation			
Brome	2500	4700	3100	4000	6500	4500
CWG	2700	5200	3400	3200	6300	4700
IWG	3300	4700	3600	3900	6000	5300
Alfalfa	4100	-	-	5000	-	-
			Cultivation Mean			
Brome	2400	4800	4100	3500	6100	4300
CWG	2700	5600	4300	2800	6200	4400
IWG	3000	5100	4200	3500	6100	5300
Alfalfa	4100	-	-	5200	-	-

irrigated grasses, the potential for higher yields at higher rates must be considered. Even at the rate used in this experiment, fertilized grass yielded more than alfalfa. However, plant analysis showed a lower protein concentration in the grass compared to the alfalfa and this may decide which crop is grown.

Finally, it should be noted that the three grasses grown in this test all yielded about the same. Bromegrass is usually the grass grown on irrigation, but these results indicate that under the adverse growing conditions of these irrigation areas, no grass can be considered more suitable than the others.

Because of the drought conditions that occurred during the three years data were collected, any conclusions drawn from the results must be considered preliminary. However, it can be concluded that the advantages of deeper preseed tillage are marginal, that phosphorus seems to be a major key to increased production, and that grasses fertilized with nitrogen and phosphorus will give higher yields than alfalfa, but at a lower protein concentration. Finally, as in all studies of this kind, a consideration of the economics involved will be the final decider to any recommendations arising from this study. Meanwhile, observations will continue for several more years to confirm these results. Other studies on the effect of cereal breakcrops, effect of manure amendments, the effect of rates of N and P on both grasses and alfalfa, and an alfalfa variety trial will also continue and will be reported on when results become available.